

WATER CRISES, ISRAEL

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ABSTRACT

The purpose of this contribution is, much has recently been written on the subject of the Middle East water crisis, a great deal of it highly apocalyptic in tone. Water is a highly politicized issue in the Middle East, and the many alarm bells are ringing because of this inseparability of water and politics. Water is a key area of dispute: nevertheless many claims concerning the water crisis are hyperbolic and misleading. Water is a critical area of dispute in the Arab-Israeli conflict; but given the current climate of peacemaking, and given the general war-weariness among states and populations, such predictions are excitable pieces of subjectivism. A little more calm objectivity is needed.

Much of the subject is shrouded in a fog of misinformation. Erroneous data and misleading claims often lead to mistaken understandings of the conflict's roots. In such instances, factual errors serve to suggest that all parties (Israelis, Palestinians and Jordanians) suffer from a general shortage of water affecting the region. In reality, the water crisis is not chiefly one of insufficient supply, but of uneven and unequitable distribution. There needs to be an increased awareness that Israel and Palestine are arid areas, where water is naturally a scarce resource, and where water consumption should be appropriate to these facts of nature. While supply enhancement may become salient at some future point, allocation of existing supply is the issue that should be prioritized.

It is upon the issue of water maldistribution that this paper will therefore focus. While some consideration will be paid to water supply and consumption in the Middle East as a whole, the emphasis will be upon the Palestinian-Israeli dispute, which is perceived to be the central element in the conflict. This contribution is helpful for understanding the causes, effects and solutions for water wars and conflicts due to water, happening within Middle East. And, focusing towards the future problems rising within the rest of nations within the world as water is so valuable for living lives.

KEYWORDS: Water Wars, Water Problems, Israeli Water Dispute, Water in Israel, National Water Carrier, Supply of Water in Israel, Mekorot, Israel, Palestine, Jordan, Shortage of Water, Water Networks Rehabilitation Fund, Wastewater Renovation and Reuse, Sea of Galilee, Politics for Water, Peace, International Water, Water Resources in Israel

INTRODUCTION

Water Challenge

Israel is the driest country in the region with no major rivers and only one lake of sweet water (Sea of Galilee). Almost 50% of Israel's landmass is arid and rainfall is scanty. The population of the country has increased more than 12 times since its inception in 1948 and is currently around 8 million. Per capita consumption is 250 liters. The country is surrounded by a tough neighborhood which compels it to be near self-sufficient in agriculture. Demand from agriculture sector is almost 50% of total demand.

Natural water refill: 1170 MCM (per year); Water consumption: 2030 MCM (per year). That means there is annual shortfall of 45%. In addition to its population, Israel has to share water resources with the Palestinian Authority and Gaza strip (population 3.5 million).

An ambitious irrigation network called National Water Carrier was planned even before the state of Israel was born which brings water from the Sea of Galilee to South Israel (more than 200 km) pooling it with ground water. Drip Irrigation technology was invented in Israel which saves up to 50% water compared to traditional methods. Israel is a pioneer in RO technology and desalination on industrial scale. Today Israel recycles more than 80% of water which will go up to 95% by the end of next year.

Yet, the crisis faced by Israel is not over as its population will continue to grow for years to come and the due to climate change, the rainfall in the region has become even more unpredictable. The constant threat of wars and terrorist attacks makes its water infrastructure vulnerable and could jeopardize its water security. Though Israel has come a long way from where it was at the beginning of 20th century, it still needs to do more.

CAUSES OF THE PROBLEM ON HAND

Geography of Israel

The geography of Israel is very diverse, as desert conditions in the south, and snow-capped mountains in the north. The south of Israel is dominated by the Negev desert covering more than half of the country's total land area. The north of the Negev contains the Judean Desert, which, at its border contains the Dead Sea.

The inland area of central Israel is dominated by the Judean Hills of the West Bank, whilst the central and northern coastline consists of the flat and fertile coastal plain. Inland, the northern region consists of the Mount Carmel mountain range, which is followed inland by the fertile Jezreel Valley, and then the hilly Galilee region. The Sea of Galilee is located beyond this. Israel is located at the eastern end of the Mediterranean Sea in western Asia.

Climate: Consist

Israel has a Mediterranean climate with long, hot & rainless summers and relatively short, cool & rainy winters. The climate is so due to the location between the subtropical aridity of the Sahara and the Arabian deserts and the subtropical humidity of the Levant and Eastern Mediterranean. The climate conditions are highly variable within the state and modified locally by altitude, latitude, and the proximity to the Mediterranean.

Summers are very humid along the Mediterranean coast but dry in the central highlands, the Rift Valley, and the Negev Desert. More than 70% of the average rainfall in Israel falls between November and March; the months from June to September are usually rainless. Rainfall is unevenly distributed, significantly lower in the south of the country. In the extreme south, rainfall averages near 30 millimeters annually. But, in the north, average annual rainfall exceeds 900 millimeters. Rainfall varies from season to season and from year to year, particularly in the Negev Desert. Precipitation is often concentrated in violent storms, causing erosion and flash floods. In winter, precipitation often takes the form of snow at the higher elevations of the central highlands. Mount Hermon has seasonal snow which covers all of its peaks for most of the year in winter and spring. On rare occasions, snow gets to the northern mountain peaks and only in extremely odd occasions even to the coast. The areas of the country most cultivated are those receiving more than 300 millimeters (11.8 in) of rainfall annually, making approximately one-third of the country cultivable.

Heat waves are frequent. 2010 was the hottest year in the history of Israel with absolute record high in several places in August. October and November were also dry, and November was almost rainless when it was supposed to be rainy.

Rivers and Lakes

Israel's longest and most famous river, River Jordan, is the 320 km long which starts on the southern slopes of Mount Hermon. The river flows south through the freshwater Sea of Galilee eventually emptying into the Dead Sea. The northern tributaries to the Jordan are the Dan, Banias, and Hasbani. Only the Dan is within undisputed Israel. The Hasbani flows from Lebanon and the Banias from territory captured from Syria. The Sea of Galilee (also called the Kinneret) is Israel's most important freshwater lake covering 166 sqKm. To the south of the Kinneret lies the saltwater Dead Sea. There are no navigable, artificial waterways in Israel, although the National Water Carrier, a conduit for drinking water, might be classified as such. The idea of a channel connecting the Mediterranean and Dead Seas or the Red and Dead Seas has been discussed.

Environmental Challenges

Air Pollution: Israel's major cities, Jerusalem, Tel Aviv and Haifa, as well as industrial centers like Ashdod, face severe air-pollution problems, primarily from industrial and automobile emissions. In 2003, the Israel Union for Environmental Defense (IUED) published the results of a study it conducted with the U. S. Environmental Protection Agency that indicated that 1,400 Israelis die each year from exposure to air pollution in Tel Aviv and Ashdod alone. This is more than twice the number of Israelis who die annually due to traffic accidents and terrorist acts combined.

Water Pollution: All of Israel's rivers, except those flowing through sparsely populated areas, are much more polluted than rivers in Europe and the United States. Israel ranks 88th out of 122 selected countries in terms of water quality, according to the 2003 United Nations World Water Development Report. A recent nationwide survey found that more than half of Israel's drinking-water wells are significantly polluted.

Wars & Terrorist Attacks

The Israeli experience with terrorism can be divided into major types as, the first type includes terrorism originating from over Israel's borders and perpetrated by Palestinian or Islamic groups that have created a military infrastructure in neighboring countries. The second type is international terrorism against Israeli targets outside Israel's borders including aviation terrorism initiated by Palestinian groups from the late 1960s to the late 1970s as well as attacks against Israeli diplomatic facilities and representatives during roughly the same period. The third type includes attacks perpetrated within the State of Israel by groups whose organizational infrastructure is located inside Israel or in areas under Israeli control. These include the cases of Palestinian violence during the Intifadas and the various attacks that occurred between these two clashes; namely the campaigns of suicide attacks initiated by Hamas and the PIJ in the 1990s.

Population Density and Loss of Open Space

Israel is one of the world's most densely populated countries. With more than 8 million people in a country about the size of New Jersey, Israel is more densely populated than India. Safeguarding its precious land resources is a major national challenge. This will be more critical as Israel's population continues to grow. Poor planning and improper development is leading to accelerated suburbanization in Israel's densely populated central region.

EFFECTS AS A RESULT OF THE PROBLEM ON HAND

Water is considered as a national resource of utmost importance. It is vital to ensure the population's well-being and quality of life and to preserve the rural-agricultural sector. Israel has suffered from a chronic water shortage for years. In recent years however, the situation has developed into a crisis so severe that it is feared that by the next summer it may be difficult to adequately supply municipal and household water requirements. The current cumulative deficit in Israel's renewable water resources amounts to approximately 2 billion cubic meters, an amount equal to the annual consumption of the State. The deficit has also led to the qualitative deterioration of potable aquifer water resources that have, in part, become either of brackish quality or otherwise become polluted.

The 1967 war, although it was not a “war for water”, did have water as one of its main stakes. The conflict was concluded with Israel acquiring a positional advantage along the upper Jordan, and thus *de facto* taking control of the main regional water resources. Israel achieved this through its occupation of Golan, which is crossed by the tributaries of the upper course of the Jordan and West Bank, with the rich aquifers of Mountain, and the coastal aquifer of Gaza. The rough control of Golan, Israel gained total control of the Jordan and was able to use water as a negotiating weapon. The occupation of this strategic area thwarted the Arab countries' water diverting plans. The only source that remained outside of Israel's control was the Hasbani, which originates in southeast Lebanon.

Among the Arab countries, Jordan was the one whose water problems were most aggravated by the conflict. It lost West Bank and, as a consequence, its access to the Mountain aquifers; its water needs were increased by the immigration of about 300,000 Palestinian refugees; and it suffered the effects of the extension of Israeli control along the north bank of the Yarmuk from 6 to 12 kilometers. Jordan was forced to accept the new geopolitical situation as ineluctable. The water dispute thus entered into a pragmatic phase during which the country, aware of its weakness, strove to maximize its access to ever scarcer water resources through technical agreements with Israel that did not challenge the new status quo.

Direct control of the aquifer and introduced strict restrictions on its use by the local Palestinian populations, notably:

The digging of wells without permission from the Israeli authorities was prohibited under military ordinance 158 of 30 October 1967. Such permission was only given sporadically, and only for domestic use.

Pumping was forbidden along the mountain ridge overlying the Yarkon-Taninim aquifer.

The use of earlier wells adjoining Israeli wells was prohibited. These restrictions were imposed because the aquifer flows westward, and the West Bank rainwater hence feeds into areas within Israeli territory. Thus, these limitations to Palestinian exploitation of the area uphill of the aquifer resulted in an increased availability of water in the downhill area exploited by Israel. The years after the occupation witnessed a *de facto* congealing of Palestinian water consumption, which actually increased, but very slightly, especially when compared with the Palestinian population's high rate of demographic growth.

The failure of all attempts at cooperation in environmental protection in the years following the signing of the Oslo agreement has been largely determined by the two populations' different perceptions of the objectives of the peace process and its modes of enactment. The Israelis are mainly interested in setting up a regional cooperation that would allow

them to dodge the thorny issue of the partition of the water of the Mountain aquifer. This explains their attempts to revive major water transfer projects such as the importation of water from Turkey via Antalya, the Peace Canal, and the proposed Red Sea-Dead Sea conduit, as well as their huge investments in research on new desalting technologies. At the same time, Israel is inclined to limit its cooperation with the Palestinians to technical aspects connected to the qualitative deterioration of water resources, such as the joint management of wastewater collection and processing systems by Palestinian villages and Israeli settlements. The Palestinians, on their part, although they agree on the need for cooperative effort to safeguard water resources, see the problem from a political perspective. They prioritize gaining recognition of their rights to the Mountain aquifer and the drawing up of an allocation plan. This explains the refusal of Palestinian municipalities to cooperate with the Israeli settlements within the Palestinian Territories, as this would imply recognizing the legitimacy of the colonies. Water has become, once again, the terrain on which political distances and contrasting objectives are gauged and weighed, and this amplifies the pressure on resources.

Furthermore, ever since the second Intifada, political emergency has caused what limited control and regulation power had existed previously in the sector to lapse, allowing non-sustainable ways of exploiting water resources to spread even more.

The causes of the crisis are both natural and man-made. Israel has suffered from four consecutive years of drought. The increase in demand for water for domestic uses, caused by population growth and the rising standard of living, together with the need to supply water pursuant to international undertakings have led to over-utilization of its renewable water sources.

The policy for the water sector, particularly in the past decade, combined with the absence of adequate action facing the impending water shortage situation, has contributed to the severity of the present crisis. The agricultural sector has suffered most because of the crisis. Due to the shortage, water allocations to the sector had to be reduced drastically causing a reduction in the agricultural productivity. The current crisis has led to the realization that a master plan for policy, institutional and operational changes is required to stabilize the situation and to improve Israel's water balance with a long-term perspective.

SOLUTIONS FOR THE PROBLEM ON HAND

Water is scarce – and what is worse, a lot of it is wasted. According to the World Bank, an astonishing 32 billion cubic meters are lost globally in urban water distribution systems every year from drips and leaks reflecting an average loss of 25% to 30% of all urban drinking water. Allowing all those drops to drip away is akin to flushing hard cash down the toilet to the tune of \$20 billion a year.

Water Use

Water use in 2009 was 1.91 billion cubic meters of which fresh water use was 1.26 billion cubic meters. Water use was 100 million cubic meters (5.2%) to Jordan and the Palestinian Authority, 1016 million cubic meters for agriculture (53.2%), 684 million cubic meters (35.8%) for domestic and public uses and 110 million cubic meters (5.7%) for industrial use. According to one estimate, average domestic water consumption in Israel is 137 liters per person per day on average, about half of indoor water use in the United States. However, according to another estimate water use per person per year is 90 cubic meter, corresponding to 247 liters per day. The latter estimate includes losses and probably also water use by offices that may not have been included in the former figures.

Sanitation

Israel generally has a modern sanitation system particularly in major Jewish towns and cities. However, a report released by the Israel Union for Environmental Defense in 2010 found that 500,000 homes in Israel are not linked to a central sewage system. The vast majority of the 150 communities are Arab communities that are having no sewage hook-up and whose waste is therefore expelled into cesspits or the local environment. Jerusalem and Ariel were reported as dumping some of their refuse into streams. Israel's Water Authority said that Israel is in the "top spot globally" for using treated waste and that only 2.7% of raw sewage flows into streams and none into the sea.

Responsibility for Water Supply and Sanitation

Responsibilities for the water and sanitation sector in Israel are defined in two key laws: The Water Law of 1959, amended most recently in 2006, and the Water and Sewerage Corporations Law of 2001.

The Minister of Energy and Water Resources (until 2012 the Minister of Infrastructures) is the Cabinet member responsible to the Parliament (the Knesset) for the management of water resources, proposing the national water policy for Cabinet approval and subsequently implementing it, as well as for Israel's external water relations. Since some aspects of the management, protection and allocation of water resources fall into the spheres of other Ministries, the exercise of certain powers requires their consent. The principal Ministries in that category are the Ministries of Agriculture (agricultural allocations and pricing), Environmental Protection (water quality standards), Health (drinking water quality), Finance (tariffs and investments) and the Interior (urban water supply). The Administration for the Development of Sewage Infrastructures, a unit in the Ministry of Energy and Water Resources, implements government policy in the field of development of sanitation.

Service Quality

According to the Ministry of Environment, 97.9% of the tests complied with drinking water quality standards. An analysis of results since 1989, when disinfection of groundwater was first introduced, has shown a constant improvement in the quality of drinking water, with the percentage of violations decreasing from 8.4% in 1989 to 2.1% in 1999. In 2000, the Minister of Health signed an amended version of public health regulations which raise chemical standards for water quality to very stringent standards. Maximum levels for 38 new chemical substances—including pesticides, organic solvents and petroleum products—were set for the first time while existing standards for nitrates, lead, cadmium and zinc were tightened. The salinity of supplied water in Israel varies from very low salinity water (10 mg/l of chlorides) from the Upper Jordan River, 200 mg/l from the Sea of Galilee, and more than 1500 mg/l from groundwater sources in the south.

Service Provision

Bulk Water Supply through Mekorot

The state-owned National Water Company (Mekorot) is responsible for bulk water supply through the National Water Carrier, transferring water from the Sea of Galilee and other sources mainly to the coastal plain. Mekorot supplies 1.5 billion cubic meters of water in an average year, 70% of Israel's entire water supply and 80% of its drinking water. It supplies water to about 4,800 intermediary water providers, including municipalities, regional associations, agricultural settlements and industrial consumers. It also operates 31 desalination plants treating nearly a million cubic meters of seawater and brackish water every day. The company's eight wastewater treatment plants, including the Dan Regional

Wastewater Treatment Plant, treat 40% of all Israel's wastewater. Its nine reclamation plants enable 70% of the treated effluent to be reused for agriculture. In 2007 the structure of Mekorot has been changed. The parent company, "Mekorot Water", continues to produce, transport and supply water. One of its subsidiaries, "Mekorot Ventures and Development", concentrates, among other things, on the desalination of seawater, wastewater treatment, projects for the municipal sector and projects abroad. Another subsidiary focuses on building and maintaining water infrastructures, primarily for the parent company. Mekorot also serves in some cases also as a Regional Water Authority. A Regional Water Authority does not have to be owned or controlled by the Government and may be owned either privately or by municipalities.

Water Distribution

Water distribution and sanitation is the responsibility of 52 regional water and sewer corporations that serve 132 local authorities with 5.5 million inhabitants. Outside their service area local authorities provide services directly to customers.

Local authorities consist of 76 cities (with a population ranging from 2,500 to 750,000 inhabitants), 144 local councils in small towns and 53 regional councils in rural areas. The Water and Sewerage Corporations Law of 2001 provides for the creation of regional companies to which local authorities would gradually transfer their water and sewerage services. The 2001 Law aims at, *inter alia*, full cost recovery and the promotion of private sector investments for infrastructure. The transfer of service provision from municipalities to public service entities (called "Water and Sewerage Corporations") is initially voluntary, but at a later stage it will become compulsory. It had been initially envisaged that by 2010 all municipal water and sewerage services would have been transferred to Water and Sewerage Corporations. The Corporations may serve the area of one or more municipality, although in the latter case all municipalities in the service coverage area have to agree. The Corporations have quality of service obligations and are required to obtain a permit from the Ministry of the Interior. The Corporations may be owned either by the municipality in whose service area they operate or by private investors. The Government may intervene in the operation of the Corporation, including transferring the provision of the services to another entity in case of failure in service provision, including in case of bankruptcy. The aim was to have only about 15 large regional water and sanitation companies. However, 52 companies had been established as of 2010 because mayors resisted the establishment of larger regional companies.

An example of a multi-municipal utility that precedes the 2001 law is the Dan Regional Sewerage Board (Shafdan), which includes seven municipalities in and around Tel Aviv. It owns the Dan waste water treatment plant, the largest wastewater treatment plant in the country which treats about 130 million cubic meters of wastewater annually for reuse in agriculture (see under reclaimed water). Mekorot operates the plant on behalf of Shafdan.

Financial Aspects and Efficiency

In Israel water tariffs are levied for all uses and at all stages of production, from groundwater abstraction, to bulk water sales to final users. Investments are financed both through self-financing from water sales revenues, through commercial debt and through various subsidies paid to municipalities and to Mekorot.

Fees and Tariffs

Domestic water tariffs charged by local authorities are set by the Ministers of Interior and Finance. They are progressive (increasing -block) tariffs. The first block is for the initial 3.5 cubic meters per month for each housing unit and

was set at NIS 9.09 (\$2.43) in 2013, with higher consumption charged at NIS 14.60 per cubic meter. In condominiums apartments usually have their own meters. In 2005 the average household expenditures on water stood at 0.9% of total household consumption expenditures. In June 2013 the Finance Ministry and the Council of Local Authorities reached agreement that the base water tariff will be reduced by 5% by the end of 2015. Water tariffs had gone up by over 30% in previous years.

Abstraction Fees, In 1999, during a severe drought, it was decided that all those extracting water from water sources would be charged with an extraction levy. The obligation for payment of the extraction levy falls on the extractor who can pass the costs on to the consumers.

Mekorot Bulk Water Tariffs

The prices Mekorot is entitled to charge are the rates set by the Ministers of Energy and Water and Finance, approved by the Knesset's Finance Committee, and updated from time to time according to the changes in the Consumer Price Index, electricity rates and the average wage index. The rates are categorized by the different uses: domestic, consumption and services, industry and agriculture. The rates for industrial and agriculture uses are lower than those for domestic consumption and services. Water for agriculture is supplied on a less reliable water supply and sanitation in Israel 10 basis and is of poorer quality. Subsidies are provided for agriculture and for remote and elevated localities. The bulk water tariff for a specific use is the same throughout the country, irrespective of the difference in costs of supplying water to a specific locality. Mekorot bulk water tariffs were increased by 25% in January 2010, to a large extent to absorb increases in electricity prices. Energy accounts for an ever larger share of water supply costs because of the increasing share of seawater desalination.

Investment & Financing

The total investment in the sector consists of investments by Mekorot in bulk water supply (including water supply for domestic uses, industry and agriculture), as well as investments by municipalities in drinking water distribution, sewerage and wastewater treatment. If half of the Mekorot investments of US\$ 240 million in 2006 can be attributed to domestic water supply (US\$ 120 million), and US\$ 125 million were invested by municipalities in sanitation (see below), total investments in drinking water supply and sanitation stood at least US\$ 245 million per year, excluding investments in desalination plants under BOO schemes and excluding investments in drinking water distribution by municipalities. Municipalities receive grants and soft loans in order to finance investments, particularly in wastewater treatment.

These subsidies are channeled through various funds, such as the Water Networks Rehabilitation Fund, the National Sewage Program and the Wastewater Renovation and Reuse Program. The State invests about NIS 450 million per year (about US\$ 125 million) in sanitation through these funds, mostly in the form of long term subsidized loans (20 years, 5% interest), and some in the form of grants.

Mekorot receives a subsidy from the Ministry of Finance to cover the difference between its supply costs and the tariffs it is allowed to charge to its customers. Between 1993 and 1999 government support to Mekorot declined from 40% to 23% of its turnover, to a large extent because of an increase in the efficiency of Mekorot. This has been induced by a change introduced in 1994, whereby Mekorot's tariffs were not set any more under a cost-plus formula, but a 2.5% annual factor for efficiency increases was built into the tariff formula. Most large-scale seawater desalination plants are being privately financed as BOT projects. The Hadera plant, for example, is led, for the first time, by a consortium of foreign

banks, and amounts to NIS 1.5 billion according to the following breakdown: 50% The European Investment Bank (EIB); 25% the French Calyon Corporate and Investment Bank, which specializes in long term projects; 25% Banco Espirito Santo (BES), a Portuguese investment bank.

CONCLUSIONS

Israel, Jordan, and the Palestinian Authority are linked by common aquifers that have been exploited to the maximum since the mid-1930s and have recently been subject to over drafting and contamination. The region's geologic and climatologic settings limit future development by conventional methods. Formal protocols need to be developed for managing these shared water resources. Assistance from international organizations and donor countries has historically been withheld because of perceived instability of the region.

Security concerns have also been an impediment to cooperative resource development by Israel and her neighbor Arab states since 1948. The Israelis are concerned that any above-ground pipeline could serve as a magnet for terrorists, similar to the Los Angeles-Owens River Aqueduct of the 1920s and the repeated attacks on a multinational oil pipeline in Colombia, which has accounted for almost half of the world's terrorist attacks the past few years (152 attacks in 2000 and 178 in 2001).

The Palestinian Authority has the greatest need for developing additional sources of water, but no formal agreement has been reached on this issue in the ongoing negotiations with Israel because of the overpowering concerns about security during the Intifada that began in 1999. Development of new water sources will be a fundamental bargaining chip for both Israel and the Palestinian Authority in future negotiations.

The only viable alternatives currently being discussed involve USAID-funded programs, similar to those granted to the Egyptians in 1979 and the Jordanians in 1994, when those countries signed peace treaties brokered by the United States which formally recognized Israel (Starr, 1995). Since 1994 the Palestinians have sought Arab funding for desalination plants, but without success. The Israelis have gone forward with construction of desalination plants, which could replace 200 million m³ in groundwater losses from the Mountain Aquifer beneath the Palestinian Authority by 2008, at a cost to Israel of at least US \$114 million/yr. This figure could triple by 2012, if the Israelis are successful in bringing more desalination plants online. The 3% annual growth of the Palestinian population demands that something be done to provide additional sources of water or armed conflict will become almost certain (Darwish, 2003). Over the next century, survivability in the harsh climate of the Middle East will be driven by economic sustainability. The most challenging aspect of expanding populations and infrastructure in Israel, Jordan, and the Palestinian Authority will be potable water. Water infrastructure needs to be constructed ahead of domestic, industrial, and political demands. Water is fundamental to life, both for bodily intake and maintenance of sanitation.

Past experience with Middle Eastern countries has shown that sustenance will most likely rely on reverse osmosis desalination of sea water, which requires significant electrical power.

After signing the 1979 peace treaty with Israel, Egyptian President Anwar Sadat said the only reason his country would ever go to war again would be to protect its water resources. In the 21st century, arid and semi-Arid Middle Eastern nations will be supporting vastly increasing populations, demanding more water than is currently available. These nations will need to employ redundant water supply systems, so the loss of one or two supply lines can be obviated by tapping into parallel or alternative sources, similar to a power grid. The United States will likely continue to serve a key role as the

region's treaty broker, facilitating foreign investment in critical engineering infrastructure. Much of that infrastructure will be vulnerable to interdiction by terrorist attacks or overt acts of war. But, these nation's water resources are inevitably intertwined, so that it will be in their mutual interests to cooperate in both the development and common defense of such infrastructure.

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